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The Emergence of Open-Source Software in China

Guohua Pan

MacEwan College, Canada

Curtis J. Bonk

Indiana University, USA

Abstract

The open-source software movement is gaining increasing momentum in China. Of the limited numbers of open-source software in China, *Red Flag Linux* stands out most strikingly, commanding 30 percent share of the Chinese software market. Unlike the spontaneity of open-source movement in North America, open-source software development in China, such as *Red Flag Linux*, is an orchestrated activity wherein different levels of China's government play a vital role in sponsoring, incubating, and using open-source software, most conspicuously, *Red Flag Linux*. While there are no reports on open-source course management system in China, there are reports on the study and use of Western open-source course management systems for instruction and learning in Chinese higher education institutions. This paper discusses the current status of open-source software in China, including open-source course management software and associated tools and resources. Importantly, it describes the development model of *Red Flag Linux*, the most successful open-source software initiative in China. In addition, it explores the possibility of Chinese higher education institutions joining efforts to develop China's own open-source course management system using the open-source development model established in North America. A timeline of current and major open-source projects of significance in China is provided. The paper concludes with a discussion of the potential for applying the open-source software development model to open and distance education in China.

Keywords: online learning; open-source software; online communities; China

Introduction

There are increasing reports related to open-source software initiatives undertaken in China. For example, China Open-Source Software Promotion Union (COPU) has recently established a 'think tank' comprising 19 prominent open-source executives from around the world. This think tank meets annually to advise COPU on promoting adoption and development of the open-source software in China (Lemon, 2006). Different levels of Chinese Governments have begun to install open-source software. To help in this initiative, the Chinese Ministry of Information founded the open-source Software Promotion Alliance to encourage the development of China's open-source software industry (Marson, 2005). In addition, the French Atomic Energy Commission and the Chinese Ministry of Science and Technology agreed to develop a new low-cost, high-performance open-source software platform, to form ". . . a complete chain of compatible open-source systems" for China (Gasperson, 2004, ¶ 7). In August 2004, Chinese software companies

Red Flag Software, *Beijing Co-Create open-source*, *Zhongbiao Software*, *Wuxi Evermore Software*, *Kingsoft*, and *Beijing Redflag Chinese 2000* joined forces with *IBM*, *Hewlett-Packard*, *Intel*, and *Novell*, to form the China open-source Software Promotion Alliance, China's first open-source software organization. This alliance is aimed at cooperating in *Linux* development, promoting open-source development and application in China, and driving exchanges and cooperation of open-source communities in northeast Asia (Legard, 2004). Not surprisingly, such increasing interest in open-source software. This activity is also evidenced on *Google*: A *Google* search of the word 'open-source in China ' on January 4, 2007 returned 109 million webpage hits.

In spite of all the buzz, however, open-source software is a more recent phenomenon in China than in North America. There is limited open-source software available locally and there is no report yet regarding mature open-source communities in China. For many Chinese educational institutions, open-source software is a merely an alternative to expensive proprietary software. Of course, there are myriad technical issues faced by China, including extremely large character sets, lack of conventional Western alphabetic sorting, failure of automatic translation engines, and so forth (Yeates, 2005).

Not surprisingly, many questions and issues are consistently raised concerning the open-source movement in China. For instance, what are the key issues of open-source movement in China? How does – or will – open-source work there? What are advantages and disadvantages of applying open-source to Chinese higher education, and to open and distance learning in China in particular? Through telephone and email communications with various scholars in China, coupled with an in-depth analysis of related reports, publications, and other data acquired from the Internet on the current status of open-source software development and associated open-source models in China, we explore some answers to the above questions and the potential for a development model that may be applied to higher education, and, to open and distance learning in China, in particular.

Open-source Software and Development Model in China

To a large extent, the success of open-source software in China is closely linked to '*Zhong Ke Hong Qi*,' a Linux operating system branded under the *Red Flag* name developed and distributed at the Software Research Institute of The Chinese Academy of Sciences. Founded in 2000, *Red Flag Linux* has been upgrading its product and services steadily and is poised to be an effective alternative to *Microsoft's Windows* operating system in China (Red Flag Linux, 2005; Wikipedia, *n.d.*, a). On November 11, 2005, Red Flag Linux 5.0 was published as a comprehensive desktop operating system (Red Flag Linux, 2005; Wikipedia, *n.d.*, a). Currently, the product of Red Flag Linux consists of:

- Red Flag DC Server 5.0 (红旗数据中心服务器5.0)
- Red Flag Linux Desktop 4.1 (红旗Linux桌面版4.1)
- Red Flag Linux Workstation 5.0 (红旗Linux工作站5.0).

There is a high resemblance in terms of desktop operations and icons between *Red Flag Linux* and *Windows NT*, which, according the *Red Flag Software Co., Ltd.*, eases conversion and change processes related to operating system transition. It is believed that the manageability and ease of

use of *Red Flag Linux* are improved significantly from *Red Hat Linux* [a popular Linux distribution assembled by *Red Hat* in Raleigh, North Carolina, USA. The open-source version has been released in the name of *Fedora Core* since 2003], while the *Red Flag Linux*'s internal structure is similar to that of *Red Hat Linux* (Red Flag Software Co, 2006; Wikipedia, *n.d.*, b). In fact, according to a recent report, about 30 percent of desktops in China now use *Linux* (eWEEK.com, 2005).

From its inception, *Red Flag Linux* was a government initiative that aimed at developing China's open-source software industry. As such, governments have been behind the *Red Flag Linux*, with government-owned Shanghai NewMargin Venture Capital and CCIDNET Investment, a venture capital arm of the Ministry of Information Industry, as the two largest financial shareholders of *Red Flag Linux*. The Chinese Government's enthusiasm for open-source software is partly due to lower cost, partly due to benefits to the local industry, and partly due to cultural and political reasons – in particular, distrust of American imperialism (Marson, 2005).

Linux does not require user licenses, so it is economically accessible for many institutions and individuals who cannot afford proprietary software. As part of these economic initiatives, by supporting *Red Flag Linux*, the Chinese Government hopes to create and grow its own information technology industry, along with a user-base that uses such Chinese technology. It is also a way to combat software piracy. Indeed, a recent study found that 90 percent of all software used in China was pirated (Trombly & Davis, 2005).

Culturally and politically, some members of the Chinese Government have been concerned that there could be secretly embedded codes in *Microsoft* software that the U.S. Government can manipulate, which would allow the U.S. to bring down China's computing infrastructure. Not too surprisingly, "the Chinese Government is a bit paranoid about having proprietary code; it is worried about a back door into its systems," according to Madanmohan Rao, a research director at the Asian Media Information and Communication Centre (Marson, 2005, Summary, ¶ 11).

Although no relevant report is available, the development of *Red Flag Linux* is likely an orchestrated endeavor organized by the Software Research Institute. The Software Research Institute is a government institution wherein most, if not all, members of developing community are from the same institution and are physically clustered together. It is likely that the development team is hierarchical since it is mainly based on an existing organization. Consequently, it may be reasonable to expect that a higher level of efficiency, and possibly, higher effectiveness, exists in terms of version production than a non-institutional open-source development community that is *laissez-faire*. Moreover, the product can expect a fairly extensive user-base, simply because it is supported by different levels of the Chinese Government.

Local, provincial, and national Chinese Governments, indeed, have supported the product by installing and using *Red Flag Linux*. Among them are the National Ministry of Science, the Ministry of Statistics and the National Labour Unit, the China Post, the Chinese Academy of Sciences, the National Foreign Exchange Management Bureau, the Custom General Office, China Tobacco, the Digital Library project of universities, the Public Security and China Banking Regulatory Commission, and the National Development and Reform Commission (Red Flag Software Co, 2006). Beijing municipality, the Chinese capital, was also reported to have installed *Linux* on 2,000 desktops. Clearly, the future for *Red Flag Linux* looks very bright in China. In fact, the Chinese Government has recently announced that all government agencies are required to use only "locally produced software" with a goal of 100 percent compliance by 2010 (DeGroot, 2006, A Boost for Linux? ¶ 2).

While the focus in this section has been *Linux*, it is not the only open-source initiative presently occurring in China. In fact, there are a few other less-known open-source Chinese software projects that, because of their insignificance in terms of user base and influence, are not discussed here.

Clearly, there are a plethora of benefits and opportunities related to the open-source software in China. Basically, the open-source model of software development, through *Linux*, has shown and provided the Chinese people with an alternative method for software development that is now considered as an effective approach to combat problems linked to software in China: piracy, security, and high cost. In addition, use of open-source software extensively for effective learning and instruction promises great potential for the public at large, and for higher education and open and distance learning, in particular. As is discussed in the next section, the Chinese higher education sector was among the earliest advocates of open-source software and has been playing an increasingly vital role in advancing open-source software in China.

Open Source Software and Higher Education in China: Reality and possibilities

Financing has been one of the driving forces behind open-source software development in China (Miro International Pty Ltd, 2006; Wang, 2004). As a developing country, China was ranked by the World Bank (2004) as 118 in terms of human living standards, based on the data of "Atlas Methodology"¹ and "Purchasing Power Parity."² Interestingly, higher education institutions in China have always had severe financial constraints similar to their Western counterparts in terms of base budgets for information technology (IT) licensing fees, training, and support required for application software (Hu, 2005; Yeats, 2005). Financial constraints faced by Chinese colleges and universities, however, tend to be more acute than their Western counterparts primarily because China is a developing country with a per capita GDP just over US \$1,000 in 2003. Open-source software, such as *Linux*, may therefore be a potential solution to ameliorate financial constraints faced by many higher education institutions, and address issues of software piracy that is currently widespread in China.

Besides various financial constraints and considerations, open-source software also is viewed as an opportunity for China to utilize millions of talented, university-educated individuals in its quest to develop its own brand of copyrighted software to combat the monopoly of Microsoft in China's software market (China Economic Net, 2004; GEEK.com, 2000; MacNewsWorld, 2003). Indeed, as of 2003, China had 11,736,000 undergraduate and 501,000 graduate students attending colleges and universities (Chinese Ministry of Education, 2005; Huang & Zhou, 2005). Each student is exposed to course-related, as well as institutional software decisions, on a daily basis. The resulting knowledge of software tools, features, and functionalities among such a large number of college educated individuals yields considerable 'people power' when it comes to the development of open-source software. With such power, open-source solutions offer opportunities not only to control costs, but also expanded access to the tools students need to learn, as well as engage in collaborative projects.

According to research, one of the earliest open-source software programs introduced to higher education institutions in China was likely *Scilab*, an open-source numerical computational package developed by the French National Institute for Research in Computer Science and Control (INRIA) for system control and signal processing applications. As early as 2001, The Sino-French Laboratory in Computer Sciences, Automation, and Applied Mathematics (LIAMA), together with a cluster of Chinese universities and INRIA began to promote *Scilab* in China ". . .

to strengthen the research exchanges and collaborations between Chinese and French researchers via the platform of Scilab" (Hu, 2005, p. 3) . Based on the success of the *Scilab* project, INRIA and Advanced Computing Technology of the High-Tech Research and Development Program (HTRDP), also known as Program 863, signed a memorandum of understanding on November 4, 2005 to promote the adoption of open-source middleware worldwide. Some of the Chinese universities involved in this collaboration included The Beihang University, Peking University, National University of Defense Technology, and the Institute of Software of Chinese Academy of Sciences (ObjectWeb, 2005).

One case of an open-source software application within a higher education institution was reported by Wang (2004) who was the IT person looking after the campus Intra/ Internet at Tourism College, Jinan University in Guangzhou, Canton, China. The tourism college had wanted to build its own Intranet with Internet access, but was unable to do so because it was handcuffed by a limited budget. Having downloaded *Linux SAMBA* and purchasing an *IBM21 Y* server, the college built its first Intranet for staff to share files and print documents. Next, the college upgraded its *Linux* to *Red Flag Linux 2.0* and built a Web server capable of high-speed Internet access.

Although there are not many reported cases of open-source applications in higher education institutions, *Red Flag Linux* is on its way to widespread adoption and use in China, including extensive use within higher education settings. Moreover, the business model of open-source software development has been evolving from initial *Linux* companies such as *Red Flag Linux* under the Software Research Institute to larger, open-source communities comprised of mostly higher education institutions. In June 2005, for example, the Zhengjiang Linux Center (ZJLC) and over 70 universities established China's first Leadership of open-source University Promotion Alliance (LUPA) to create, innovate, and modernize the nature of open-source (LUPA, 2006). Three months later, LUPA established Lupaworld (i.e., LUPA 开源社区), "a new open-source community" where members exchange ideas and hone skills related to open-source (Yang, 2005, ¶ 3). Today, LUPA has its own website and consists of over 100 universities including such top universities as Qing Hua, Peking, and Zhejiang (LUPA, 2006). A similar initiative was announced in November, 2005, when 27 universities and Guangdong Linux Center (GDLIC) set up the Guangdong Leadership of open-source University Promotion Alliance (GDLUPA). The GDLUPA has founded several Linux Practical Bases to train university students as *Linux* programmers. Ultimately, GDLUPA hopes that those students will help *Linux* diffuse more fully within China as they take their skill-base with them to wherever they may end up working after graduation (International Open-Source Network, 2005).

One recent development in open-source software applications within Chinese higher education worth noting, is the *localization* of open-source software systems from Western countries. *Localization* is a term used by Chinese scholars to mean customization of software into Chinese. In fact, Beijing University, mentioned above, has taken a leadership role in this regard by localizing three open-source software products: 1) *Websurvey* (a course survey and evaluation system); 2) *Sakai* (a course management system) and; 3) *EduCommons* (an open courseware tool). At the present time, the university is planning for use of other open-source systems such as *uPortal*, *Dspace*, and *Fedora* (Zhao, 2006). In addition to these efforts, Beijing University of Science and Technology and the University of Guangxi Nationality have also been using *Sakai* for their respective course management systems.

Perhaps the best known locally produced open-source project in education might be the China Quality OpenCourseWare (CNQOCW, 中国精品课程导航) project initiated by the Chinese Ministry of Education, Massachusetts Institute of Technology (MIT), the William and Flora Hewlett Foundation, and Dr. Fun-Den Wang in 2003 (CORE, 2007a). CNQOCW, like MIT's OpenCourseWare initiative, aims to share quality Chinese educational resources with the world. In effect, opencourseware projects, which are now evident around the globe – notably in the USA, UK, Japan, Vietnam, India, and so forth – place course materials or resources on the Web using open-source tools such as *EduCommons* developed by Utah State University (Johnstone, 2005). Such resources could include a course syllabus, assignments, lecture notes, instructor *PowerPoint* slides, tests, readings, and various audio or video files (Jaschik, 2006).

While learners can browse and use such resources and materials, there typically is no instructor or tutor grading one's work, nor is any course credit typically assigned for completion of such materials. The materials are made available to anyone with Internet access. This means that information can be disseminated to potential students, along with the marketing of high-quality courses. Universities such as Tufts University, MIT, and the Johns Hopkins University in the United States, the Open University in the United Kingdom, Waseda University in Japan, and the National University of Vietnam, are among the initial leaders of the opencourseware movement.

China too, wants to be a leader in this area. In 2006, 751 national-level quality courses were selected from member universities nationwide under the supervision of Chinese Ministry of Education, which were subsequently translated, assembled, and published on the CORE site (CORE, 2006b). CORE stands for China Open Resources for Education (中国开放式教育资源共享协会). China's Ministry of Education plans to publish 1,500 national-level quality courses on the CORE website by the end of 2007. As noted in Table 1, the lead universities in CORE include Tsinghua University, Peking University, Beijing Normal University, Beijing Jiaotong University, Dalian University of Technology, Central South University (CSU), Xi'an Jiaotong University, Central Radio and TV University, Sichuan University, Zhejiang University, Tibet University, University of International Business and Economics, and Northeast Agricultural University) (COREd, 2007b). These are among the China's most prestigious universities.

In addition to CORE, there are efforts being made by volunteers at the Opensource Opencourseware Prototype System (OOPS 開放式課程計畫) project to translate MIT's OCW courses (including video lectures) into Chinese (Lin, 2006; Lin & Lee, 2006). The OOPS project has two websites for translated MIT courses, one for traditional Chinese and one for simplified Chinese. Unlike CORE, the OOPS project is based in Taiwan.

The OOPS project was initiated and originally self-funded by Lucifer Chu, a young entrepreneur who is widely known for his efforts in translating the *Lord of Rings* books to Chinese as well as in founding and directing The Foundation of Fantasy Culture and Arts (Lin, 2006). Among Chu's mottos are that "perfect translations do not exist" and "collective minds are better than a single translator" (*personal communication*, May 26, 2006, ¶ 1). His business card, in fact, indicates that his title is the "Janitor of OOPS." According to Chu (*personal communication*, January 1, 2007), OOPS has 2,012 volunteer translators, 1,125 courses which have been adopted for translation, and 639 courses near completion in terms of translation. According to Chu, as of January 1, 2007, 126 open-source courses at MIT have been translated into Chinese, while many more are currently in the process of being translated (OOPS, 2006). Interestingly, Chu's army of volunteers, which, unlike its CORE counterpart, is based on an open-source model of

volunteerism, not only does translation work but also editing, proofreading, technical services and support, administrative support, and marketing and promotions. These volunteers come from countries around the globe, but most are from Taiwan and mainland China. Given the number of courses adopted for translation, as well as those completed, when combined with the high energy, talent, and charisma, and general effusive nature of Chu, this project has been attracting much attention, including recent funding from the Hewlett Foundation, along with fascinating research into the OOPS translation culture (Lin & Lee, 2006). Of course, there is also some pointed criticism and pervading tensions in that like *Wikipedia*, OOPS relies on volunteers from all walks of life, not translations purchased from high ranking universities and institutes.

Users of *Moodle* are also found in China, in four versions – Chinese (simplified), Chinese (Simplified) UTF8, Chinese (Traditional/ Big5), and Chinese (Traditional/ Big5) UTF8 (Coppola & Neelley, 2005; Moodle, 2005b; Wikipedia, *n.d.*, a). While at present there is no accurate number available regarding institutions using Chinese versions of *Moodle*, Beijing University is one of the universities reported to have been using *Moodle* (Zhao, 2006). Our count of *Moodle* sites in mainland China (Moodle, 2007) was well over 100, including Peking University and Tsinghua University, while Taiwan had nearly 300 sites listed including Aojiang High School Online(鳌江中学在线教学平台), along with other primary, junior high, and secondary schools and higher education institutions. Martin Dougiamas (*personal communication*, January 4, 2007), the founder and developer of *Moodle*, advised that there was so much interest and activity related to *Moodle* in China that one university he visited in Beijing in 2005 had approximately 20 educational technology Masters and Doctoral students conducting research on it. Such intense research on *Moodle* could be viewed as a sign of the acceptance and growing importance of open-source software within Chinese higher education.

Open-Source in China: The momentum builds

A striking feature of those open-source initiatives in China is that the Chinese government is determined to have open-source software substitute for *Microsoft's Windows* operating systems and associated software, and, at the same time, localizing Western course management systems. As a result, minimal efforts have been reported on the development of course management systems designed to meet the needs of educational organizations within China. Another interesting feature is that those open-source projects in existence, most notably the *Red Flag Linux*, have been initiated, developed, and distributed by a software research institution under China Academy of Sciences, with limited, if any, contribution from higher education institutions. Although colleges and universities have become increasingly involved in the *Red Flag Linux* project recently, such involvement focuses primarily on programming skills and proliferation of open-source software (ChinaTechNews.com, 2005; eWEEK.com, 2005; Hu, 2005; Huang, 2006; International Open-Source Network, 2005; Zhao, 2006). There is no reported educational open-source project initiated by colleges and universities in China which is similar to *uPortal*, *Sakai*, or *Moodle* in North America. Nor are there any colleges and universities that have developed and diffused similar course management systems in China akin to *Moodle* or *Sakai*. This will likely change, however, as certainly in the coming years we will see significant development in such open-source software within China's higher education sector.

Considering the financial constraints that over 2000 Chinese colleges and universities are currently experiencing, and which will not subside for the foreseeable future, as well as the massive number of university-educated individuals in China, we are of the opinion that Chinese colleges and universities, like their counterparts in North America, can and should join hands to develop education-related open-source software. Such software development will not only

increase capacity for higher education institutions and organizations in China, but form the starting points for partnership discussions with colleges and universities in other countries involved in the open-source movement or seeking new opportunities. The education-related open-source software movement in China will not only address financial constraints faced by most educational institutions in China, it promises to build upon and expand the social and intellectual capital that each participating organization has to offer. Of equal significance, the open-source movement will tap the vast pool of talents each higher education institution holds, nurturing their initiative and innovation, as well as their retention and loyalty (Chinese Ministry of Education, 2005).

Forming a consortium is one option for colleges and universities to become involved in education-related open-source projects in China. Based on the experience of *LionShare*, *OSPI*, and *Sakai*, several Chinese colleges and universities with similar needs and resources – perhaps backed by a key software vendor or foundation – might collaborate to develop a course management system on the basis of existing courseware or online projects the member institutions currently use. Further, the establishment of LUPA as well as GDLUPA offers the opportunity for software vendors and higher education institutions in China to delve one step further than simply promoting programming skills and disseminating, proliferating, and diffusing open-source software. Chinese colleges and universities can also be seen as 'greenhouses' for open-source course management systems and other software that not only meet the specific needs of participating institutions, but, equally important, nurture and encourage the initiative and innovation of the tens of millions of talented individuals studying at colleges and universities within China.

The open-source model is gaining momentum in China, which in turn is creating a favorable situation for Chinese higher education institutions to initiate highly visible open-source projects. On December 26, 2005, for example, China announced the establishment of the open-source Community of China with three founding partners: 1) the Center of Software and Integrated Circuit Promotion (CSIP) under the Ministry of Information Industry; 2) the China OSS Promotion Union (COPU), and; 3) the China Linux Industry Strategic Alliance (ChinaTechNews.com, 2005). According to ChinaTechNews.com (2005) the goal of The open-source Community of China is to create an atmosphere for open-source software development through government guidance, active participation of enterprises and individuals as well as domestic and international cooperation.

Although no higher education institution was represented within this open-source community, it does not mean that Chinese colleges and universities cannot join the community through (domestic) cooperation. And while no open-source course management software or other system or tool specific to higher education was mentioned in the announcement, it does not imply that such systems or tools will not emerge from this effort. Indeed, it may be an excellent opportunity for some colleges and universities to combine forces – both in terms of financial and human expertise – and take the initiative and build their own open-source projects. Indeed, with support from the Chinese Government, universities are taking initiative to tap the application, and, possibly, the development of open-source course management systems in Chinese higher education. For instance, CORE convened an Open Education Conference 2006 in Xian, China from September 6 to 9, 2006, its third such conference since its inception in 2003. Participants were administrators and academics from Chinese and American universities, as well as representatives from the William and Flora Hewlett Foundation and the International Engineering Technology Educational Foundation, two US foundations involved in funding the CORE project

and now the OOPS project as well. Of the 20 presentations at the conference, seven were on, or related to, open-source software or courseware (CORE, 2006b).

Open-Source Movement in China: Approaches and milestones

The open-source model of software development did not find its way into China until 1999, when *Red Flag Linux 1.0* was released by *Red Flag Software Co., Ltd.* Since its inception in 1999, there have been numerous open-source projects undertaken by individuals and organizations in China, with some open-source projects playing a more significant role in advancing the open-source model of software development than others. Appendix 1 presents a brief introduction to some of the open-source projects or events in China that we feel are of significance in the advancement of open-source model of software development.

A further look into the approaches of the open-source projects reveals that, in China, open-source projects have been generally initiated by organizations with government support. For example, Red Flag Linux, the only reported financially successful open-source project in China, was initiated by the Computing Software Research Institute under the Chinese Academic of Sciences, a quasi government institution at the national level dealing with scientific research. As such, the initiative aimed at addressing the needs of organizations guided by the government, rather than individual needs. Scilab, which involved many Chinese universities, was another open-source project initiated by a government initiative between China and France.

While most open-source education-related projects in North America typically involve a few closely linked collaborating universities, a similar endeavor in China typically involves ten or more universities (see Table 1). There are advantages and disadvantages of each approach to open-source development. One advantage of involving many institutions is the availability of a vast pool of talent for the project. Another advantage is the financial resources individual institutions bring with them (Wheeler, 2004). Larger partnerships can simultaneously address issues related to achieving sustainable economies at the institutional level, while at the same time nurturing innovation and deep learning among students and instructors. Despite such advantages, however, challenging and dysfunctional organizational issues might arise due to too many competing member interests and agendas to coordinate. When such challenging conditions occurs, efficiency can be compromised. There might also be issues related to dominating and being dominated (Daft, 2004), with some member institutions playing a more prominent role than others.

Finally, it seems that the open-source movement in China is gaining momentum as more news related to open-source is reported in recent years. Most of this news, however, is related to open-source operating systems such as *Red Flag Linux*, or the localization of Western course management systems such as *Sakai*, and not to innovations and independent development of open-source software related to education such as course management software or other educational opportunities. As such, it appears that China is experiencing what North America accomplished in the early 2000s. What higher education institutions are currently developing and implementing in North America in terms of open-source software, as well as their many collaborative efforts, conferences, and forums (Pan & Bonk, *in press*), may serve as examples to which Chinese higher education institutions might aspire – to address or perhaps find and expand upon areas in which China can take a leadership role in the open-source movement.

A salient feature of the open-source model is distributed development. Raymond (1997), for example, noted that the source code of the prototype software is open and freely available to the

users who are potential co-developers, even though the source code only has limited functionalities. This 'gift culture' and distributed development is further manifested in the Open-source Initiative's (2007) introduction to the idea of open-source: "When programmers can read, re-distribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs" (¶ 2). This is a gift culture that allows individuals to access source code freely. In effect, distributed development calls those same people, in one way or another, to participate in improving the prototype such that it becomes more sophisticated over time (i.e., equipped with additional and more stable functionalities). This give-and-take process, in turn, creates an obligation for people to give back when a gift is given (Ubiquity, 2004; Weber, 2006). Of course, the values and beliefs of the giver may also be passed on to the recipients, a dynamic which therefore binds people together.

Open-Source Software for Open and Distance Learning in China

Distance and e-learning development in higher education is increasingly researched, discussed, and documented in both Chinese educational systems. For instance, Zhang and Huang (2006) conducted a study on e-learning in Taiwan's higher education and found that distance education in Taiwan, especially that related to e-learning, targets traditional full-time students – not non-traditional individuals, such as full time workers. Equally problematic, according to government regulations, distance education credits can only consist of a one-third maximum of a student's total required credits for any degree program.

Zhang and Huang (2006) also report that no distance degree program exists in Taiwan. Instead, e-learning courses are typically supplementary courses offered in highly-demanded subject areas such as Literature and English Language, Engineering, and Management. As such, e-learning in Taiwan has shades of elitism, given that e-learning courses are not made available to all students, including non-traditional students. Indeed, one must first pass the national entrance exam and be admitted as a traditional full-time student to be eligible to take an e-learning course in Taiwan. Zhang and Huang also note that e-learning course credits are non-transferable among universities, unless a special arrangement has been made between the institutions concerned. Moreover, they found that a 'shovel-ware' approach is typically used wherein the same materials and format used in face-to-face course delivery are simply digitized for e-learning delivery.

Distance education in mainland China takes four forms: 1) educational CD display centers, 2) satellite TV learning centers, 3) networked computer labs, and, more recently, 4) Web-based learning (Deng, 2005; Potter, 2003; Zhang, 2005). There are over 15.8 million non-traditional students who take distance courses offered in one of these four forms (Wang & Kreysa, 2006). One of the major distance education providers is the Central Radio and Television University (CRTVU 中央电大) with over 100,000 students enrolled. Increasingly, the Internet is being used in China to make education available to more students with more flexibility (Zhang, 2005). Chinese distance educators utilize such methods as personalizing instruction, relating to prior experience, assessing student needs, building effective learning climates, and participating in the learning process.

Yet, as with the situation in Taiwan noted above, those in mainland China also typically view themselves as merely knowledge providers and see distance education as the mere duplication of the classroom experience in their adoption of similar 'shovel-ware' instructional methods found in Taiwan (Potter, 2003; Wang & Kreysa, 2006). Chinese distance education method is seen as teacher-directed (content-centered), information-based, and test-driven (Wang & Kreysa, 2006).

As such, distance education is often denigrated for its focus on lower-order thinking skills such as knowledge, comprehension, and memorization, while instructional design principles and models are often ignored (Potter, 2003; Zhang, 2005). It seems that mass transmission of knowledge is favored over interactive, engaging, and thoughtful pedagogy.

The distributed development or 'gift culture' of the open-source model is applicable to open and distance learning through the ease and flexibility of learner participation in a virtual community. Access to a virtual community can result in software development that can accommodate the diverse needs of online learners and instructors at different stages of their life cycles and online experience and can help lead to effective learning and instruction (Anderson, 2004). A virtual community of practice is possible among Chinese students, instructors, and open-source software developers; it can focus virtual community members on open and distance learner needs and provide continued results of pilot testing. At the same time, Chinese open and distance learners can share their ideas and needs when using the CORE or OOPS systems or any other open-source resource, tool, or system development available to them. Communities of distance learners as well as online instructors, can provide ideas in discussion forums, online communities, and interest groups. In effect, as with open-source software development, such online forums provide a world of possible human assistance and a distributed development culture.

Anderson (2004) notes that such transactions typically occur through asynchronous communication tools and are grounded in existing knowledge contexts. When this occurs, open and distance learners and instructors can increasingly look at things from similar paradigms and interact with each other and negotiate meanings out of "a common ground of interest and understanding" (Bonk & Cunningham, 1998, p. 31). Consciously or unconsciously, such open and distance learners use the language and act in ways that are acceptable to them. A culture, thus, begins to form that unites online learners and instructors and makes them feel an increasing sense of belonging to each other. Various participant interactions afforded by the Web's communication tools can enhance educational transactions in this virtual community, including student-student interaction, student-teacher interaction, student-content interaction, teacher-teacher interaction, teacher-content interaction, and content-content interaction (Anderson, 2004).

Now imagine such virtual communities of online learners and instructors impacting the open-source movement in China. As indicated above, there are myriad outlets and communication flows for idea and knowledge sharing which can enhance the development, use, and evaluation of open-source software tools and resources. But will open-source projects in the field of higher education take advantage of them? And, if they do, how will this be made evident? Clearly, the givers need not only be software programmers and developers; users, too, have real power in such environments.

At the same time, the expanded possibilities afforded by open-source models can be overwhelming to distance learning instructors as well as students. It remains a challenge to maintain open and distance instructors and learners' interest and commitment to the projects they are involved in because of the spontaneous and informal aspects of participation. Why would online learners or instructors offer advice when they are in the midst of a course and such advice will not impact their grades or course performance, if a learner, or their pay, if an instructor? Why share? What do they receive in return? And if they do feel an impulse to share, how will instructor or student needs within open-source software be expressed, documented, and addressed? Just who will listen to their needs and how will they respond? Will they have training in 'customer' support? Where will resources emerge for addressing software changes that such a learning community of educators and students might suggest?

In China such communities of instructors and learners face additional challenges. For instance, open and distance learners face a credibility issue, especially since a mere 4 percent of the universities in China credit the online courses offered by another university, while only 15 percent of Chinese universities and colleges are offering online (credit) courses (HC360.com 慧聪网, 2005). While such numbers significantly lower the potential strength of such a culture today, it is conceivable that in just a few short years, the tide of change related to acceptance and implementation of online learning in China will place millions of online learners and thousands of online instructors in positions of influence related to the open-source movement. As Huang and Zhuo (2006) and others observe (Deng, 2005; Zhang, 2005), while numerous problems exist, blended and fully online learning will continue to develop in China, as well as in Taiwan, and other Chinese speaking countries and regions (Zhang & Hung, 2006) during the next few years.

Conclusion

In this paper, we analyze the status of open-source development in China. We examine the current situation of open-source initiatives undertaken in China and find few and limited open-source projects that are geared to the needs of educational institutions. We believe that the lack of open-source course management software offers opportunities for Chinese colleges and universities to build open-source course management software on their own – or in partnership – with other institutions and organizations. Given these open-source trends of the past decade, and especially the past few years, there are many exciting opportunities for research and development within higher education in China and beyond.

Gift culture and distributed development enable the success of open-source software such as *Linux* and the birth and growth of open-source courseware projects such as CORE and OOPS. Gift culture and distributed development might simultaneously help build and consolidate a community of practice of open-source software developers within higher education; especially related to online learning tools and resources including instructional designers, online educators, and virtual students. This gift culture and distributed development also can be mirrored open and distance learning practices by building and reinforcing a community of open and distance learners, online instructors, instructional designers, and other educational professionals who lend insights into their needs, as well as potential directions of the open-source movement, that can benefit online learning in higher education and other sectors.

Given the potential for enormous demands for online learning in China, if and when that happens, the influence of China in the open-source movement will be extensive and potentially relentless. As that occurs, no longer will the thrust within the open-source movement be from North America to China, but, instead, it will be pushing, and not too gently, from China back to North America and all other parts of the world. This reverse migration of open-source ideas, tools, and resources is something, of course, which the entire world of higher education will be intently watching. Stay tuned!

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Appendix 1. Important open-source Projects in China and in North America

Date	Sponsor	Project	Significance
1999	Red Flag Software Co., The Chinese Academy of Sciences	<i>Red Flag Linux</i>	First open source computer software project in China.
2001	INRIA, France and LIAMA, China	<i>Scilab</i> Workshop	First open source software in China focused on higher education
2002	Chinese and French governments and Universities	<i>Scilab</i> Contest	The contest helped to promote educational open source software in China.
2002	Wikipedia, the free encyclopedia	Chinese Wikipedia	First open source content project in China.
2003	William and Flora Hewlett Foundation and International Engineering Technology Educational Foundation	China Open Resources for Education (CORE) to create high quality courseware in China	First OpenCourseWare in China with some Chinese university courses freely available to anyone anywhere anytime. CORE participants are transcribing MIT opencourseware to Chinese. Universities involved in CORE include Tsinghua University, Peking University, Beijing Normal University, Beijing Jiaotong University, Dalian University of Technology, Central South University (CSU), Xi'an Jiaotong University, Central Radio and TV University, Sichuan University, Zhejiang University, Tibet University, University of International Business and Economics, and Northeast Agricultural University
2004	Red Flag Beijing Co-Create Open Source, Beijing <i>Redflag Chinese 2000</i> , <i>Hewlett-Packard Co.</i> , <i>IBM Corp.</i> , <i>Intel Corp.</i> , <i>Novell Inc.</i> , <i>Red Flag Linux</i> .	China Open Source Software Promotion Alliance	Start of a new stage in the promotion of open-source software in China and across northeast Asia.
2004	Fantasy Foundation (headed by Lucifer Chu) and more recently the Hewlett Foundation has provided some funding to continue the OOPS initiative.	Opensource Opencourseware Prototype System (OOPS)	First open source project to translate MIT OpenCourseWare courses into Chinese.
2005	Zhengjiang Linux Center (ZJLC) and more than 70 Chinese universities	Leadership of Open Source University Promotion Alliance (LUPA)	Open source software vendor and such prestigious universities as Peking, Qinghua, Zhejian, join hands to promote open source software in higher education
2005	China OSS Promotion Union, China Linux Industry Strategic Alliance, Center of Software and Integrated Circuit Promotion	Open Source Community of China	First national level alliance to promote open source in China
2006	CORE	Open Education Conference 2006	Promoting open source courseware and open source software in China; in Chinese higher education, in particular.

Notes

1. Atlas Methodology, or Atlas Method is a statistic method that the World Bank uses to calculate gross national income (GNI) and GNI per capita in U.S. dollars in order to reduce the impact of exchange rate fluctuations in the cross-country comparison of national incomes.
2. Purchasing Power Parity is the method of using the long-run equilibrium exchange rate of two currencies to equalize the currencies' purchasing power. A purchasing power parity exchange rate equalizes the purchasing power of different currencies in their home countries for a given basket of goods. These special exchange rates are often used to compare the standards of living of two or more countries. The adjustments are meant to give a better picture than comparing gross domestic products (GDP) using market exchange rates.

